

BRAIN POWER MATH: NON-ROUTINE PROBLEM SOLVING

This resource is a set of 50 non-routine math problems that require students to utilize critical thinking and problem-solving skills. Each and every problem is completely unique, and can be solved in multiple ways.

Incorporating non-routine problem solving into your math program is one of the most impactful steps you can take as an educator. By consistently allowing your students to grapple with these challenging problems, you are helping them acquire essential problem-solving skills and the confidence needed to successfully execute them.

This resource comes in three different formats:

1. Printables: These are full 8.5 x 11 pages that contain the problem, a "Problem Solving Check-List," and a check-list to help guide students' responses.
2. Task Cards: These contain just the problem and are formatted 4 to a page. They can be laminated and used in a center or for independent work.
3. Journal Strips: These contain just the problem and are formatted 4 to a page. They can be printed, cut apart, and glued into an Interactive Notebook or math journal.

The three different formats included make it simple for you to adapt this resource to meet the needs of your students. Instructional applications include: morning work/bell-ringers, independent work, math centers, cooperative learning, and whole-group instruction.

I have also included DETAILED explanations and diagrams on how to solve each problem. The only preparation you'll need to do is read the problem and my explanation; you'll then be ready to facilitate some major "Brain Power" in your classroom! You will be amazed by the creative strategies and rich discussions that will take place among your students.

Questions or comments? Please email me at info@teacherthrive.com

Thank you for your purchase,

Melissa Tallman

www.TeacherThrive.com

THE FOUR-STEP PROBLEM-SOLVING METHOD

This method provides a simple and general guide for students when working to solve challenging math problems. Before sending students off to tackle these problems, I recommend teaching the students these four steps by directly modeling their application while you solve a problem in a whole-group instructional setting. Conducting this type of “think aloud” will really help your students to be successful when they are given their own problems to work with. I have also provided a simple little check-list on the printables to remind students to apply the steps themselves.

1. Understand the Problem:

This step requires that students read the problem at least twice; on the third reading, they will underline any important information in the problem.

Questions for your students to consider during this step might include:

- Does the problem present enough information? Is there too much information?
- What is the main question being asked?
- What should your solution look like?

2. Plan How to Solve the Problem:

Once students understand the problem, they can begin to think of a strategy or strategies to solve the problem. Here is a list of commonly used strategies for solving non-routine problems:

- Drawing a diagram or picture
- Making an organized list
- Making a table
- Solving a simpler related problem
- Finding a pattern
- Trial and error / guess and check
- Experimenting
- Acting out the problem
- Working backwards
- Bar models
- Writing an equation

3. Execute Your Plan:

It's now time to put pencil to paper! If the problem solving involves two or more steps, remind your students to review their work after each step.

4. Review Your Work:

This is often an overlooked step. Students sometimes believe when they are finished with a problem, there is no need to look back at their work. During this step students should:

- Check the reasonableness of their solution.
- Write their answer in a complete sentence: this requires them to revisit the main question being asked.
- Extend the problem: Can details of the problem be changed to create a new problem?

INSTRUCTIONAL APPLICATIONS

You have a number of options on how you can present these problems to your students.

1. Whole Group: You can project a problem for the whole class to see using an LCD or overhead projector. Students may work on whiteboards, or simply use paper and pencil to solve the problem. The work can be done independently, or you can have students work together in pairs or small groups. In the latter option, I would require all students to write down the work on their own whiteboard or paper. This whole group option can follow with a few students presenting their plan for solving the problem; this is a nice opportunity for the class to see multiple strategies that can be used to solve the same problem.
2. Independent Work: Students can have their problem ready anytime they need to be working independently (i.e. fast-finishers, centers, morning work, etc.)
3. Cooperative Learning: Pair up students to work on a problem together. This is a valuable option, because it adds the instructional benefits of communication and collaboration to the process.

PRESENTATION

One last thing to consider: In addition to the above applications, think about how you would like your students to share or present their work. This is an important component for a number of reasons:

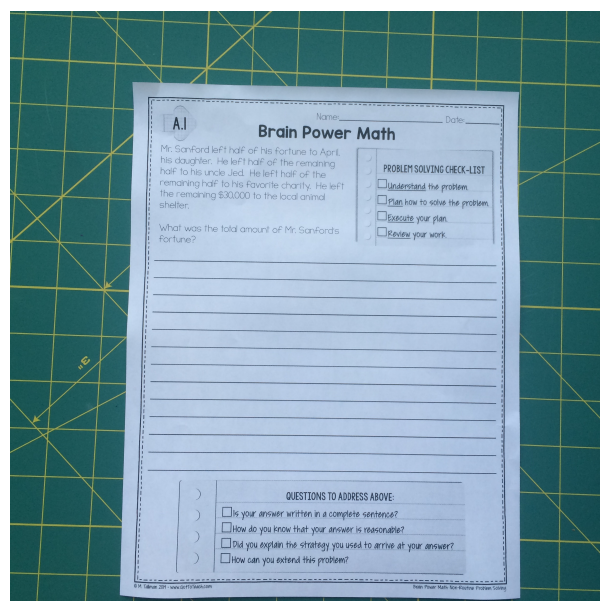
- It holds students accountable for their work.
- It provides students with an important opportunity to explain their problem-solving processes.
- It allows other students to see a variety of ways to solve a problem.
- It provides students with a “time to shine” as they present their work to others.

Students can present in a number of ways:

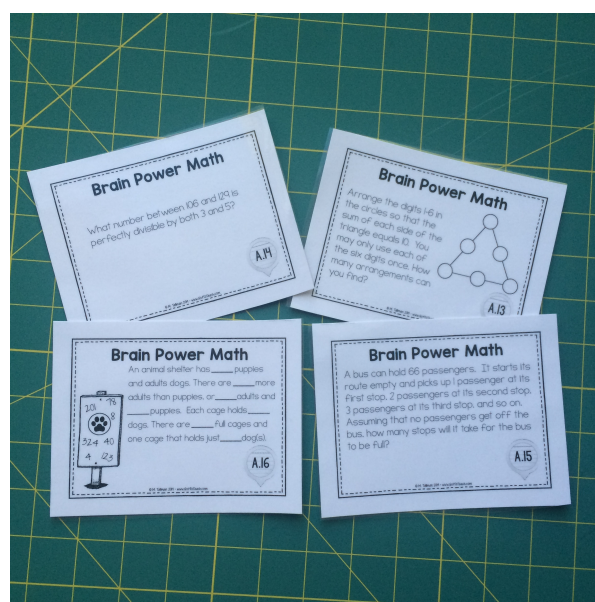
- They can present their work to the whole class, basically conducting their own “think aloud” similar to what the teacher has done when he/she directly modeled the process to the class.
- They can present their work to another student or small group of students.
- They can present their work to a parent or an older sibling.
- They can present their work on an online forum (i.e., Edmodo, etc.) hosted by the teacher.

3 Different Formats

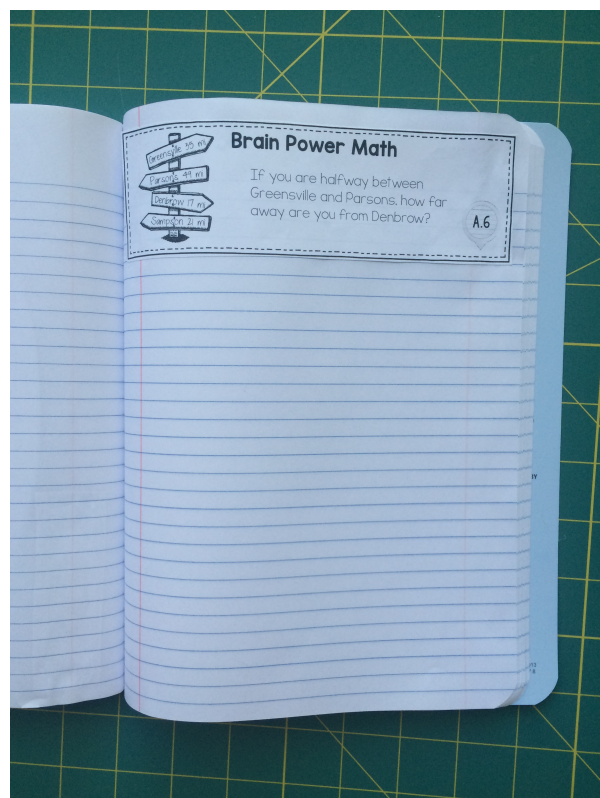
Printables

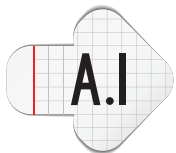


Task Cards



Journal Strips





Name: _____ Date: _____

Brain Power Math

Mr. Sanford left half of his fortune to April, his daughter. He left half of the remaining half to his uncle Jed. He left half of the remaining half to his favorite charity. He left the remaining \$30,000 to the local animal shelter.

What was the total amount of Mr. Sanford's fortune?

PROBLEM SOLVING CHECK-LIST

- ☐ Understand the problem.
- ☐ Plan how to solve the problem.
- ☐ Execute your plan.
- ☐ Review your work.

Printables

QUESTIONS TO ADDRESS ABOVE:

- ☐ Is your answer written in a complete sentence?
- ☐ How do you know that your answer is reasonable?
- ☐ Did you explain the strategy you used to arrive at your answer?
- ☐ How can you extend this problem?

Brain Power Math

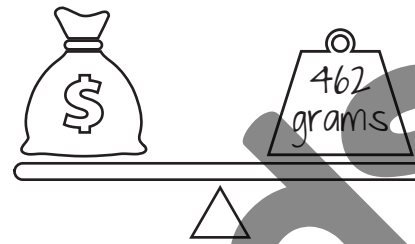
In this addition problem, each letter stands for a different digit. What digits do the letters C, T, and N stand for?

$$\begin{array}{r} C\ T \\ C\ T \\ C\ T \\ + C\ T \\ \hline N\ C \end{array}$$

A.9

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Brain Power Math



1 penny = 3 grams
1 nickel = 5 grams
1 dime = 2 grams
1 quarter = 6 grams

This bag full of coins weighs 462 grams. What is the greatest value of money that could be in the bag?

A.10

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Brain Power Math

If you write every whole number from 1 to 100, how many times will you write the digit "2"? Can you solve this without actually writing out each number from 1 to 100?

A.11

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Brain Power Math

You have exactly 10 coins with a total value is \$1. Three of the coins are quarters. What are the remaining coins?

A.12

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Brain Power Math

Mr. Sanford left half of his fortune to April, his daughter. He left half of the remaining half to his uncle Jed. He left half of the remaining half to his favorite charity. He left the remaining \$30,000 to the local animal shelter.

What was the total amount of Mr. Sanford's fortune?

A.1

Brain Power Math

If today is Wednesday, what day of the week will it be 100 days from now?

A.2

Brain Power Math

You have three rods that are 5 cm, 7cm, and 9 cm long. Explain how you can use these rods to measure a length of 11 cm long.

A.3

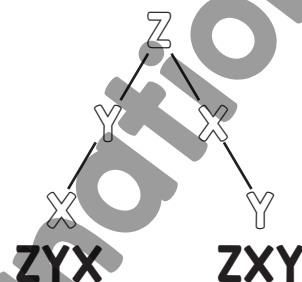
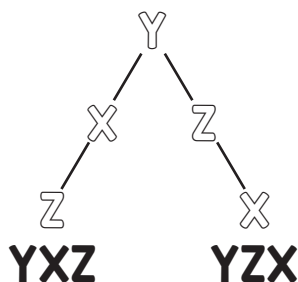
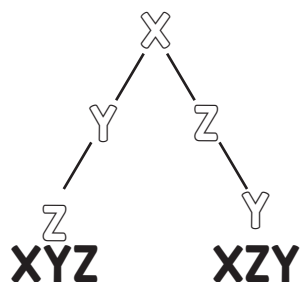
Brain Power Math

How many different three-letter combinations can you make using the letters X, Y, and Z. Each letter can be used only once in a combination.

A.4

A.4 Solution

Organization is key for this type of problem. Drawing "Tree Diagrams" is a helpful strategy for this.



The "Tree Diagrams" provide a great visual for the 6 different combinations that are possible.

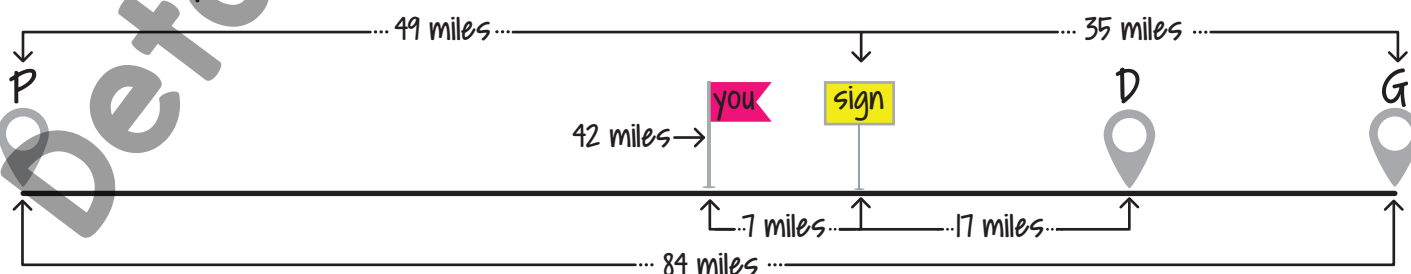
A.5 Solution

Solving this problem requires that students consider two things: how many possible numerical sums there are when rolling two dice and how many ways exist for two dice to form the sums. Using a table will help students organize this information. The table clearly shows there are 36 different possible ways the dice could land. 5 of these 36 possibilities result in rolling a sum of 6. Therefore, the probability of rolling a sum of 6 is 5 out of 36.

	die #1					
die #2	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

A.6 Solution

Draw a diagram with all the information that you know: Parsons is 49 miles to the left of the sign, Greenville is 35 miles to the right of the sign. In order to find your placement on the diagram, you need to find the distance between Parsons and Greenville and divide by two ($49 + 35 = 84$. $84 \div 2 = 42$). To find your distance from the sign you will need to subtract 42 from 49 (the distance between the sign and Parsons), which means you are 7 miles away from the sign. Add 7 miles plus 17 miles (the distance between the sign and Denbrow) to get your distance from Denbrow; you are 24 miles away from Denbrow.



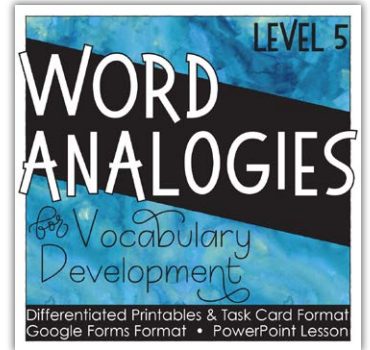
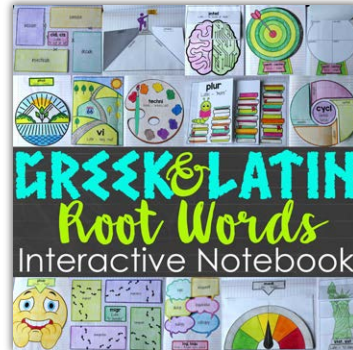
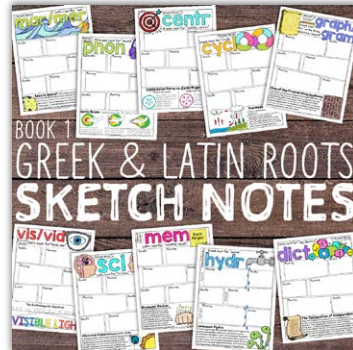
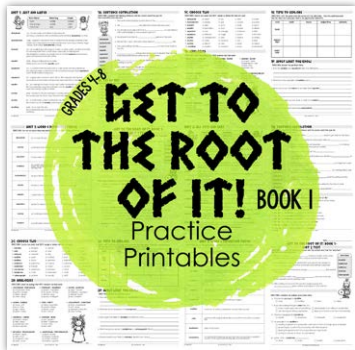


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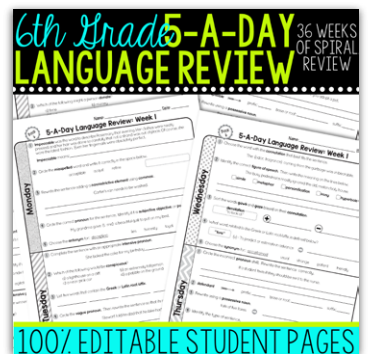
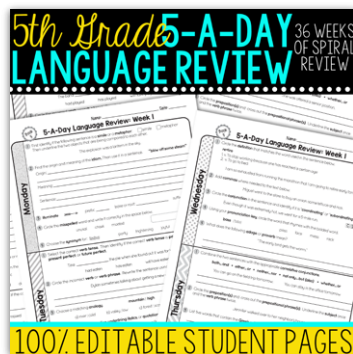
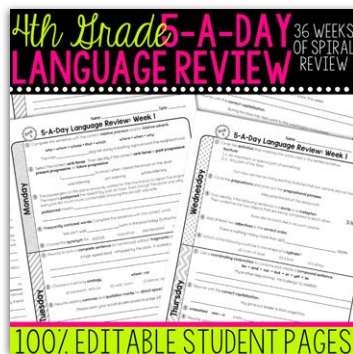
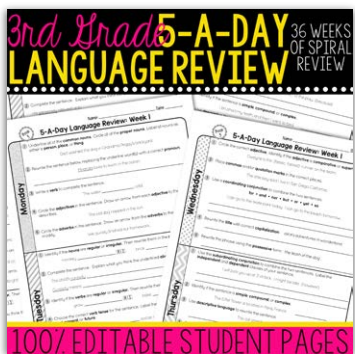


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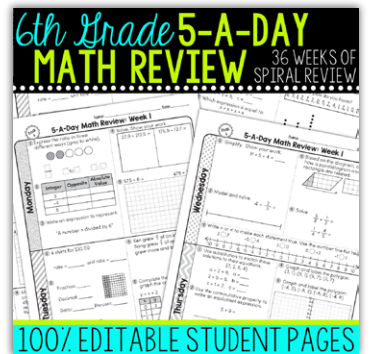
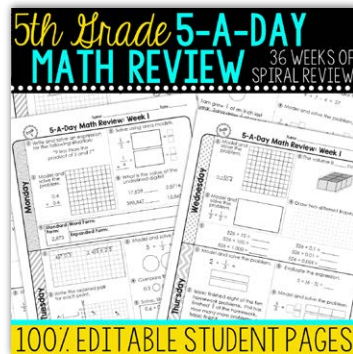
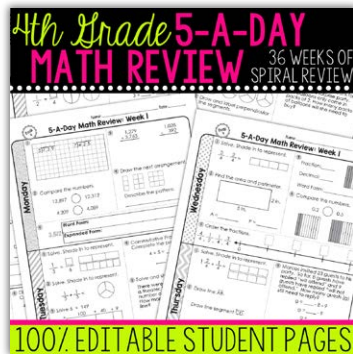
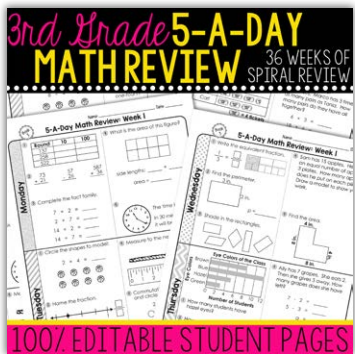
VOCABULARY RESOURCES



DAILY LANGUAGE REVIEWS (GRADES 3-8)



DAILY MATH REVIEWS (GRADES 3-6)



HANDS-ON MATH TILES

